

MANUAL
FOR
PB3531 40KHz INVERTER
(HONEYWELL SCD #10109741)

CEA Berkleonics, Inc.

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MANUAL

FOR

PB3531 40KHz INVERTER (HONEYWELL SCD #10109741)

1.0 APPLICATION

The Model PB3531 Inverter was designed to be used in Honeywell TISS Test Stations to supply 40KHz stimulus to Units Under Test. The specifications are valid when driving UUT's that present a resistive load to the Inverter.

2.0 DESCRIPTION

2.1 ELECTRICAL

The Model PB3531 40KHz Inverter operates from 115V, 60Hz single phase power and is capable of providing 200 volts peak to peak square wave voltage at 1.3 amps peak on two outputs, 180 Degree out of phase.

The output amplitude and frequency are adjustable $\pm 5\%$ with internal controls.

2.2 MECHANICAL

The Inverter is designed to mount in a standard 19" rack, has chassis slides attached and is provided with a 12 foot power cord.

The size is 5.22" high by 17" deep excluding connectors. The rear 7" should not have any airflow restrictions above or below.

The Front Panel includes an input circuit breaker with indicator lamp, an output meter with selector switch and the output connections. All other connections are made at the rear.

Internally, most of the parts are on three plug in cards: 2 100VDC Power Supply Assemblies and 1 Inverter Assembly.

3.0 SPECIFICATIONS

3.1 GENERAL

Front Panel Meter Accuracy	$\pm 3\%$
Circuit Breaker Rating	5 Amps
Operating Temperature.	0-50 Deg. C
Weight	42 LBS.

3.2 INPUT POWER

Voltage.	115V rms $\pm 10\%$
Frequency.	60Hz $\pm 10\%$
Phase.	Single
Current (At Rated Load).	4.8 Amps Max.

3.3 OUTPUT POWER (AT RATED LOAD)

Frequency.	40KHz $\pm 5\%$
Frequency Stability.	$\pm .02\%$ /Deg. C (0-55 Deg. C)
Rise And Fall Time (-90V to +90V)	.8 to 2 Microseconds
Overshoot.	.5V Peak Max.
Ringling.	1V Peak to Peak Max.
Settling Time.	5 Microseconds Max.
Droop.	.2V Max.
Impedance.	Less than 1 ohm (DC-200KHz)
DC Offset.	$\pm 1V$ Max.
Symmetry	50% $\pm 4\%$ (48% to 52%)
Amplitude.	200V (P-P) Nominal, adjustable $\pm 5\%$ and settable to $\pm 2\%$.
Amplitude Stability.	$\pm .1\%$ / Deg. C (0-55 Deg. C)
Current.	1.3 Amps Peak, Min. each phase with resistive loads at both outputs.
Load Regulation.	$\pm 1\%$ (10% to 100% load)
Line Regulation.	$\pm .5\%$ (103.5 to 126.5)

4.0 OPERATION

4.1 CONNECTIONS

An Input Power Cord is provided and should be connected from the input receptacle (J1) to 115V, 60Hz power with the circuit breaker (CB1) in the OFF position.

All other cables are user supplied and are detailed in the external wiring diagram.

Connections to the Test Receptacle (J3) and the DFI Receptacle (J5) provide internal status signals and are user optional.

The Output Receptacle (J2) should be connected to the load and the output control receptacle (J4) should be connected to a switch rated at 28VDC, .05 amp.

4.2 CONTROLS

Switching the circuit breaker (CB1) to ON with the control leads (Pins A and B of J4) open will provide power to all internal circuitry. However, the Phase A HIGH and Phase B HIGH output leads and the Front Panel Meter will not be connected.

Shorting the control leads energizes K202 connecting 40KHZ power to the output connector (J2) and the Front Panel Meter.

Meter Switch (S1) provides for monitoring Phase A output voltage and current, and Phase B output voltage and current.

For safety reasons, when connecting the output leads to the load, the control leads should be open.

4.3

TEST VOLTAGES

Test voltages are available at the test connector (J3) independant of the status of the control leads as follows:

<u>PIN</u>	<u>FUNCTION</u>
22	.04762 Times Phase A Output
21	.04762 Times Phase B Output
20	Neutral (return of the above test voltages)
18	+100VDC divided by 10
17	+ 100VDC divided by 10 return
15	- 100VDC divided by 10
14	- 100VDC divided by 10 return
12	+24VDC divided by 10
11	+24VDC divided by 10 return
10, 13, 16, & 19	Chassis Ground

4.4

FAULT INDICATION

An Internal contact closure rated at .5 amp/100VDC occurs at Pins A and B of J5 if any of the following parameters (except for #6) are out of tolerance:

1. Over temperature (the + and -100VDC supplies are monitored)
2. -100VDC overload
3. +100VDC overload
4. -100VDC over/under voltage
5. +100VDC over/under voltage
6. Relay (K202) OFF
7. Phase A over/under voltage
8. Phase B over/under voltage
9. Inverter over/under frequency

In addition, individual fault indication is provided on Pins 1 thru 9 of the test connector (J3) in the same order as the above listing. If all of the parameters are within tolerance the voltage at these Pins with respect to neutral will be less than +1.2V. If a parameter is out of tolerance the corresponding Pin of J3 will be between +1.2V and +7.5V with respect to neutral.

4.5

ADJUSTMENTS

Three adjustments are available by removing the top cover. R263 can be used to adjust the frequency in excess of $\pm 5\%$. R123 can be used to adjust the 100VDC power supplies in excess of $\pm 5\%$. R263 is located on the center assembly and R123 is located on each of two assemblies on either side of it.

When looking at the front panel the assembly on the left will supply +100V power and the assembly on the right will supply -100V power.

5.0 THEORY OF OPERATION

5.1 GENERAL

The square wave outputs (Phase A and Phase B) are formed by alternately connecting the output lines to a regulated +100V power supply and then to a regulated -100VDC power supply. When Phase A is high (connected to the +100VDC power supply), Phase B will be low (connected to the -100VDC power supply) and viceversa. The + and -100VDC power supplies are the same and the output neutral line is formed by the connection of the negative end of the + supply to the positive end of the - supply.

Input - Output isolation is accomplished by transformers T101 (2 of them) and T201. The turns ratios of these transformers are scaled to provide, along with the necessary rectification and filtering, the proper DC voltages to power the +100VDC Regulator Assemblies and the Inverter Assembly.

5.2 INVERTER ASSEMBLY

5.2.1 SQUARE WAVE GENERATION

One half of a dual timer (U204) is used to produce a 1 to 2 microsecond negative pulse at an 80KHz rate, that is adjustable $\pm 5\%$ with R263.

This pulse is used to trigger a J-K Flip-Flop (U205) which produces two out of phase square waves at a 40KHz rate. Each of these outputs are connected to two inputs of 3-input positive and gates (U206). The third input is connected to the 1 to 2 microsecond negative pulse to create a corresponding "dead time" at the outputs of U206. The square waves at these outputs (Pins 6 and 12 of U206) which are 180 Deg. out of phase are coupled to drive transistors Q208 and Q209 which in turn drive the primaries of transformers T202 thru T203. The secondaries of these transformers drive the power switches Q110 thru Q113.

When T202 is energized by Q208, Q210 is driven ON, connecting the Phase A output line to +100VDC and Q213 is driven ON, connecting the Phase B output line to -100VDC.

During this time T203 is not energized and Q211 and Q212 are OFF. When Q208 is turned off, stored energy in T202 causes a polarity reversal, driving the bases of Q210 and Q213 negative causing a rapid turn-off of these transistors. This together with the "dead time" created at U206 guarantees that Q210 and Q213 are turned off before Q211 and Q212 are turned ON. When T203 is energized by Q209, Q211 is driven ON, connecting the Phase B output line to +100VDC and Q212 is driven ON, connecting the Phase A output line to -100VDC. When Q209 is turned off, one cycle will have been completed producing two 200V Peak to Peak square waves 180 Deg. out of phase.

To connect these outputs to the load requires energizing K202 by shorting Pins A and B of J4.

5.2.2 FAULT DETECTION

5.2.2.1 FREQUENCY

The third 3-input positive and gate of U206 is used to produce a sync signal for the 2nd half of the dual timer (U204). This timer along with 1/4 of the Quad comparator (U203) produces a DC voltage at Pins 5 and 14 of U203 that is a function of the frequency of the sync signal. This DC voltage along with a divided portion of it on Pin 6 of U203 is compared to 1/2 of the 5.1V rail. As long as the frequency is within tolerance, Pin 13 of U203 is held high which allows Q204 to be turned on by R253, holding the junction of R201 and R214 low. An out of tolerance condition, either low or high frequency will cause Pin 13 to go low turning Q204 off and allowing the junction of R201 and R214 to go high.

This in turn will turn Q203 on which turns Q202 on and Q201 off. With Q201 OFF, relay K201 is de-energized and a fault signal is generated (closed contacts).

5.2.2.2 AMPLITUDE

Both the positive and negative peaks of the Phase A and Phase B output lines are monitored individually and fed via voltage dividers to quad comparators U201 and U202. These voltages are compared to reference voltages established by VR203 and VR204. If all of the output voltages are within tolerance all of the outputs of these comparators will be held high which allows Q205 and Q206 to be turned on, holding the junctions of R202 and R215 and the junctions of R203 and R216 low. An out of tolerance condition on Phase A (either + or -) will cause the base of Q206 to go low allowing the junction of R203 and R216 to go high.

An out of tolerance condition on Phase B (either + or -) will cause the base of Q205 to go low allowing the junction of R202 and R215 to go high. Either of these conditions will generate a fault signal in the same manner that the frequency monitoring system did.

5.2.2.3 OTHER FAULT DETECTION

This assembly receives signals from other assemblies and controls ($\pm 100\text{VDC}$ over/under voltage, over current, over temperature and output control) and processes them in the same manner.

5.3 100VDC POWER SUPPLY ASSEMBLY

5.3.1 REGULATION

The unregulated voltage developed across C101 is dropped across Q101 and Q102 along with their emitter resistors and the output of the Power Supply (Pins 1 and 10 of P101). To keep the output at 100V the voltage drop across Q101 and Q102 is varied to make up for the difference between the unregulated voltage and the regulated output voltage. This is accomplished by varying the base current supplied to Q101 and Q102 with Q103 which in turn is driven by the output of one of the OP-AMPS in U101. The other OP-AMP is used to provide a constant current for the reference diode (VR103). The output of the supply is compared thru a voltage divider (R117, R121, R122 and R123) to this reference voltage (approximately 6.2V) and when the output voltage is such that the voltage at Pins 2 and 3 of U101 are equal, regulation will occur. The voltage divider ratio (sum of R121, R122 and R123 to R117) can be varied to change the output voltage.

5.3.2 CURRENT LIMITING

R106, R107 and R110 form a voltage divider that makes the emitter of Q106 approximately 3.45V negative with respect to its base. As the output load current is increased the voltage drops across R111 and R112 will decrease this voltage difference until at approximately 1.7 amps Q106 will turn on which will turn Q107 on, Q103 off and Q101 and Q102 off thereby lowering the output voltage. As the output voltage lowers the voltage drop across R111 and R112 required to maintain current limiting becomes less and the overload current folds back. When the output voltage is zero the short circuit current will be less than .35 amps.

5.3.3 OVER TEMPERATURE SHUTDOWN

S102 is wired in series with the input lines and if it opens all input power to the 100V assemblies and the inverter assembly will be removed. This will happen if the heat sinks that Q101 and Q102 are mounted to exceeds approximately 138 Deg. C.

5.3.4 FAULT DETECTION

5.3.4.1 OVER CURRENT

Under normal operation the output (Pin 14) of one of the comparators in quad comparator U102 is high and U104 is turn on. When current limiting occurs the voltage at the junction of R109 and R115 goes high, Pin 14 goes low and U104 is turned off. When this occurs Pin 7 and 8 of P101 are open circuited which is translated as a fault by the inverter assembly.

5.3.4.2 UNDER/OVER VOLTAGE

The output voltage is compared thru a voltage divider (R125, R126, R127 and R128) to a reference voltage provided by VR104. These voltages are fed to two comparators in quad comparator U102. When Pin 5 is positive and Pin 6 negative with respect to Pins 4 and 7 the two outputs (Pins 1 and 2) will be high and U103 will be turned on. If the output voltage is too high Pin 1 will go low or if it is too low, Pin 2 will go low. Either case turns U103 off and Pins 6 and 8 of P101 are open circuited generating a fault signal.

5.3.4.3 OVER TEMPERATURE WARNING

If S101 opens a fault signal will be generated. This will happen if the heat sink that Q101 and Q102 are mounted to exceeds approximately 121 Deg. C.

6.0 CALIBRATION

The top cover must be removed to access the adjustments and due care should be taken to avoid high voltages.

6.1

FREQUENCY ADJUSTMENTS

To check the frequency of the inverter a frequency counter can be connected to either Phase A test or Phase B test. The input line voltage or output loading can be anywhere within spec., as these conditions do not affect frequency. If the frequency is out of tolerance it can be adjusted with the only potentiometer on the center assembly accessible from the top of the unit.

6.2

+100VDC ADJUSTMENT

To check the voltage of the +100VDC power supply connect a DVM with 10 Meg Ohm input resistance from +100VDC divided by 10 to +100VDC divided by 10 return.

This voltage should be approximately +10.1VDC which translates to +101VDC at the power supply output. The "extra" volt is required to make up for the voltage drop across the inverter power switches Q110 thru Q113. Line voltage will not effect this reading and loading will only have a minor effect. This voltage can be adjusted with the only potentiometer on the left hand assembly accessible from the top of the unit.

6.3

-100VDC ADJUSTMENT

To check the voltage of the -100VDC power supply connect a DVM with 10 Meg Ohm input resistance from -100VDC divided by 10 to -100VDC divided by 10 return.

This voltage should be approximately -10.1VDC which translates to -101VDC at the power supply output. The "extra" volt is required to make up for the voltage drop across the inverter power switches Q110 thru Q113. Line voltage will not effect this reading and loading will only have a minor effect. This voltage can be adjusted with the only potentiometer on the right hand assembly accessible from the top of the unit.

7.0

SERVICE

CAUTION ! The input power cord to J1 should be removed before attempting to remove modules.

The inverter was designed to be serviced by replacing modules rather than using classical trouble shooting techniques.

The fault detection systems mentioned under Theory Of Operation will pin point the troubled module. The modules are easily removed by removing the top cover, disconnecting the troubled module's cable and turning two captive screws counter clockwise.

SYMBOLDESCRIPTION

C1	CAPACITOR,	.47ufd, 600V	IMB #BA2G474
C101	CAPACITOR,	1000ufd, 200V	RUBYCON #200RP1000
C102	CAPACITOR,	.0033ufd, 100V	CERAMIC
C103	CAPACITOR,	100ufd, 50V	NICHICON #ULB1H101MPA
C104	CAPACITOR,	47ufd, 50V	NICHICON #ULB1H470MAA
C105	CAPACITOR,	.1ufd, 100V	CERAMIC
C106	CAPACITOR,	.0001ufd, 200V	CERAMIC
C107	CAPACITOR,	.1ufd, 100V	CERAMIC
C108	CAPACITOR,	.1ufd, 100V	CERAMIC
C109	CAPACITOR,	.001ufd, 200V	CERAMIC
C110	CAPACITOR,	.1ufd, 100V	CERAMIC
C111	CAPACITOR,	.1ufd, 100V	CERAMIC
C112	CAPACITOR,	.1ufd, 100V	CERAMIC
C113	CAPACITOR,	20ufd, 200V	SPRAGUE #735P206X9200ZVL
C201	CAPACITOR,	.1ufd, 100V	CERAMIC
C202	CAPACITOR,	.1ufd, 100V	CERAMIC
C203	CAPACITOR,	.1ufd, 100V	CERAMIC
C204	CAPACITOR,	.1ufd, 100V	CERAMIC
C205	CAPACITOR,	.1ufd, 100V	CERAMIC
C206	CAPACITOR,	.1ufd, 100V	CERAMIC
C207	CAPACITOR,	.1ufd, 100V	CERAMIC
C208	CAPACITOR,	.1ufd, 100V	CERAMIC
C209	CAPACITOR,	.1ufd, 100V	CERAMIC
C210	CAPACITOR,	.1ufd, 100V	CERAMIC
C211	CAPACITOR,	.01ufd, 20V	CERAMIC
C212	CAPACITOR,	.01ufd, 200V	CERAMIC
C213	CAPACITOR,	.01ufd, 200V	CERAMIC
C214	CAPACITOR,	.01ufd, 200V	CERAMIC
C215	CAPACITOR,	1000ufd, 50V	NICHICON #ULB1H102MRA
C216	CAPACITOR,	.01ufd, 200V	CERAMIC
C217	CAPACITOR,	.1ufd, 100V	CERAMIC
C218	CAPACITOR,	.1ufd, 100V	CERAMIC
C219	CAPACITOR,	.1ufd, 100V	CERAMIC
C220	CAPACITOR,	.1ufd, 100V	CERAMIC
C221	CAPACITOR,	.1ufd, 100V	CERAMIC
C222	CAPACITOR,	.1ufd, 100V	CERAMIC
C223	CAPACITOR,	.01ufd, 200V	CERAMIC
C224	CAPACITOR,	.001ufd, 500V	MICA
C225	CAPACITOR,	.001ufd, 500V	MICA
C226	CAPACITOR,	1ufd, 50V	CERAMIC
C227	CAPACITOR,	NOT USED	
C228	CAPACITOR,	NOT USED	
C229	CAPACITOR,	NOT USED	
C230	CAPACITOR,	NOT USED	
C231	CAPACITOR,	3ufd, 200V	SPRAGUE #735P305X9200SSL
C232	CAPACITOR,	3ufd, 200V	SPRAGUE #735P305X9200SSL
C233	CAPACITOR,	.0001ufd, 200V	CERAMIC
C234	CAPACITOR,	.01ufd, 200V	CERAMIC
C235	CAPACITOR,	.01ufd, 200V	CERAMIC

SYMBOLDESCRIPTION

CB1	CIRCUIT BREAKER,	AIRPAX #APL-1-1-62F-502-M or HEINEMANN #AMI-A8-A-50-20
D101	BRIDGE RECTIFIER,	GENERAL INSTRUMENT #KBPC804
D102	DIODE,	1N4006
D103	DIODE,	1N4006
D104	DIODE,	1N4006
D105	DIODE,	1N4006
D106	DIODE,	1N5550
D107	DIODE,	1N4153
D201	DIODE,	1N4006
D202	DIODE,	NOT USED
D203	DIODE,	1N4153
D204	DIODE,	1N4153
D205	DIODE,	1N4153
D206	DIODE,	1N4153
D207	DIODE,	1N4153
D208	DIODE,	1N4153
D209	DIODE,	1N4153
D210	DIODE,	1N4153
D211	DIODE,	1N4006
D212	DIODE,	1N4006
D213	DIODE,	1N4006
D214	DIODE,	1N4006
D215	DIODE,	1N4937
D216	DIODE,	1N4937
D217	DIODE,	1N4937
D218	DIODE,	1N4937
D219	BRIDGE RECTIFIER,	GENERAL INSTRUMENTS #KBPC804
D220	DIODE,	1N4153
D221	DIODE,	1N4153
D222	DIODE,	1N4937
D223	DIODE,	1N4006
D224	DIODE,	1N4006
D225	DIODE,	1N4937
D226	DIODE,	1N4006
D227	DIODE,	1N4006
D228	DIODE,	1N4937
D229	DIODE,	1N4937
D230	DIODE,	1N4937
D231	DIODE,	1N4937
D232	DIODE,	1N4937
D233	DIODE,	1N4937
D234	DIODE,	1N4937
D235	DIODE,	1N4937
D236	DIODE,	1N4937
D237	DIODE,	1N4937
D238	DIODE,	1N4937
D239	DIODE,	1N4937
D240	DIODE,	1N4937
D241	DIODE,	1N4937
D242	DIODE,	1N4937
D243	DIODE,	1N4937
D244	DIODE,	1N4153

<u>SYMBL</u>		<u>DESCRIPTION</u>
D245	DIODE,	1N4153
D246	DIODE,	1N4153
D247	DIODE,	1N4153
D248	DIODE,	1N4006
D249	DIODE,	1N4006
D250	DIODE,	1N4006
D251	DIODE,	1N4006
D252	DIODE,	1N4006
D253	DIODE,	1N4006
D254	DIODE,	1N4006
D255	DIODE,	1N4006
DS1	NEON BULB	NE2B (C7A)
J1	CONNECTOR,	AMPHENOL #160-5-N
J2	CONNECTOR,	MS3470W18-11S
J3	CONNECTOR,	MS27656T13B-35S
J4	CONNECTOR,	MS3470L8-33S
J5	CONNECTOR,	AMPHENOL #31-2225
J6	CONNECTOR,	CANNON #DA15S
J7	CONNECTOR,	CANNON #DA15S
J8	CONNECTOR,	CONNON #DD50S
K201	RELAY,	SIGMA #195TEIBIG-24S
K202	RELAY,	POTTER & BROMFIELD #KUP11D5524
L201	INDUCTOR,	CEA #A5974
L202	INDUCTOR,	CEA #A5974
M1	METER,	CEA #5942
P101	CONNECTOR,	CANNON #DA15P
P201	CONNECTOR,	CANNON #DD50P
Q101	TRANSISTOR,	MOTOROLA #MJ15011
Q102	TRANSISTOR,	MOTOROLA #MJ15011
Q103	TRANSISTOR,	2N3053
Q104	TRANSISTOR,	2N3053
Q105	TRANSISTOR,	2N4314
Q106	TRANSISTOR,	2N2907
Q107	TRANSISTOR,	2N2222
Q201	TRANSISTOR,	2N2907
Q202	TRANSISTOR,	2N2907
Q203	TRANSISTOR,	2N2222
Q204	TRANSISTOR,	2N2222
Q205	TRANSISTOR,	2N2222
Q206	TRANSISTOR,	2N2222
Q207	TRANSISTOR,	2N2222
Q208	TRANSISTOR,	CEA #A3571
Q209	TRANSISTOR,	CEA #A3571
Q210	TRANSISTOR,	CEA #A5055
Q211	TRANSISTOR,	CEA #A5055
Q212	TRANSISTOR,	CEA #A5055
Q213	TRANSISTOR,	CEA #A5055

SYMBOLDESCRIPTION

R101	RESISTOR,	27K, 2W, COMP.
R102	RESISTOR,	470 OHM, 1W, W.W.
R103	RESISTOR,	2.7K, 1/4W, COMP.
R104	RESISTOR,	2.7K, 1/4W, COMP.
R105	RESISTOR,	12K, 1/4W, COMP.
R106	RESISTOR,	715 OHM, 1/8W, 1%, M.F.
R107	RESISTOR,	715 OHM, 1/8W, 1%, M.F.
R108	RESISTOR,	1K, 1/4W, COMP.
R109	RESISTOR,	27K, 1/4W, COMP.
R110	RESISTOR,	10K, 2.5W, W.W.
R111	RESISTOR,	5 OHM, 10W, W.W.
R112	RESISTOR,	5 OHM, 10W, W.W.
R113	RESISTOR,	15 OHM, 1/4W, COMP.
R114	RESISTOR,	4.7K, 1/4W, COMP.
R115	RESISTOR,	27K, 1/4W, COMP.
R116	RESISTOR,	2.8K, 1/8W, 1%, M.F.
R117	RESISTOR,	3K, 1W, W.W.
R118	RESISTOR,	105 OHM, 1/8W, 1%, M.F.
R119	RESISTOR,	1.0K, 1/8W, 1%, M.F.
R120	RESISTOR,	6.19K, 1/8W, 1%, M.F.
R121	POTENTIOMETER,	10K, HELIPOT #72XR10K
R122	RESISTOR,	40K, 5W, W.W.
R123	POTENTIOMETER,	10K, HELIPOT #72XR10K
R124	RESISTOR,	1K, 1/4W, COMP.
R125	POTENTIOMETER,	5K, HELIPOT #72XR5K
R126	RESISTOR,	10.0K, 1/8W, 1%, M.F.
R127	RESISTOR,	1.65K, 1/8W, 1%, M.F.
R128	RESISTOR,	200K, 1/8W, 1%, M.F.
R129	RESISTOR,	649 OHM, 1/8W, 1%, M.F.
R130	RESISTOR,	27 OHM, 1/4W, COMP.
R131	RESISTOR,	4.7K, 1/4W, COMP.
R132	RESISTOR,	4.7K, 1/4W, COMP.
R133	RESISTOR,	27K, 1/4W, COMP.
R134	RESISTOR,	18K, 1/4W, COMP.
R135	RESISTOR,	1 MEG, 1/4W, COMP.
R201	RESISTOR,	100K, 1/4W, COMP.
R202	RESISTOR,	100K, 1/4W, COMP.
R203	RESISTOR,	100K, 1/4W, COMP.
R204	RESISTOR,	100K, 1/4W, COMP.
R205	RESISTOR,	100K, 1/4W, COMP.
R206	RESISTOR,	100K, 1/4W, COMP.
R207	RESISTOR,	100K, 1/4W, COMP.
R208	RESISTOR,	100K, 1/4W, COMP.
R209	RESISTOR,	100K, 1/4W, COMP.
R210	RESISTOR,	22K, 1/4W, COMP.
R211	RESISTOR,	22K, 1/4W, COMP.
R212	RESISTOR,	22K, 1/4W, COMP.
R213	RESISTOR,	1K, 1/2W, COMP.
R214	RESISTOR,	22K, 1/4W, COMP.
R215	RESISTOR,	22K, 1/4W, COMP.
R216	RESISTOR,	22K, 1/4W, COMP.
R217	RESISTOR,	22K, 1/4W, COMP.

SYMBOLDESCRIPTION

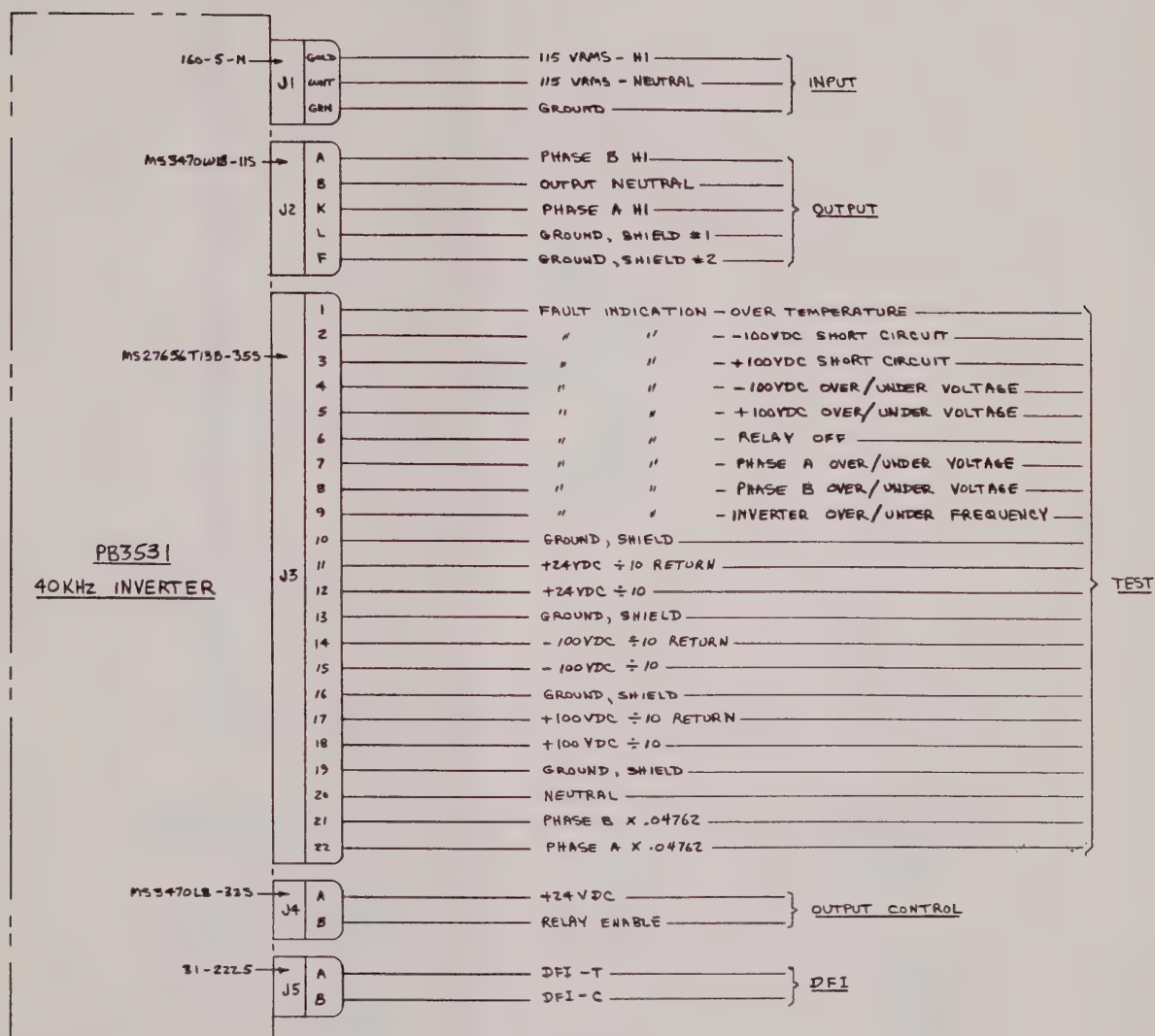
R218	RESISTOR,	22K, 1/4W, COMP.
R219	RESISTOR,	22K, 1/4W, COMP.
R220	RESISTOR,	22K, 1/4W, COMP.
R221	RESISTOR,	22K, 1/4W, COMP.
R222	RESISTOR,	22K, 1/4W, COMP.
R223	RESISTOR,	33 OHM, 1/4W, COMP.
R224	RESISTOR,	22K, 1/4W, COMP.
R225	RESISTOR,	22K, 1/4W, COMP.
R226	RESISTOR,	10K, 1/4W, COMP.
R227	RESISTOR,	10K, 1/4W, COMP.
R228	RESISTOR,	768 OHM, 1/8W, 1%, M.F.
R229	RESISTOR,	7.68K, 1/8W, 1%, M.F.
R230	RESISTOR,	1 MEG, 1/8W, 1%, M.F.
R231	RESISTOR,	10K, 1/4W, COMP.
R232	RESISTOR,	1 MEG, 1/8W, 1%, M.F.
R233	RESISTOR,	10K, 1/4W, COMP.
R234	RESISTOR,	61.9K, 1/8W, 1%, M.F.
R235	RESISTOR,	7.68K, 1/8W, 1%, M.F.
R236	RESISTOR,	61.9K, 1/8W, 1%, M.F.
R237	POTENTIOMETER,	10K, HELIPOT #72XR10K
R238	POTENTIOMETER,	10K, HELIPOT #72XR10K
R239	POTENTIOMETER,	10K, HELIPOT #72XR10K
R240	POTENTIOMETER,	10K, HELIPOT #72XR10K
R241	RESISTOR,	61.9K, 1/8W, 1%, M.F.
R242	RESISTOR,	61.9K, 1/8W, 1%, M.F.
R243	RESISTOR,	7.68K, 1/8W, 1%, M.F.
R244	RESISTOR,	1 MEG, 1/8W, 1%, M.F.
R245	RESISTOR,	10K, 1/4W, COMP.
R246	RESISTOR,	7.68K, 1/8W, 1%, M.F.
R247	RESISTOR,	1 MEG, 1/8W, 1%, M.F.
R248	RESISTOR,	10K, 1/4W, COMP.
R249	RESISTOR,	681 OHM, 1/8W, 1%, M.F.
R250	RESISTOR,	100K, 1/8W, 1%, M.F.
R251	RESISTOR,	11.0K, 1/8W, 1%, M.F.
R252	RESISTOR,	250 OHM, 5W, W.W.
R253	RESISTOR,	4.7K, 1/4W, COMP.
R254	RESISTOR,	10K, 1/4W, COMP.
R255	RESISTOR,	10.0K, 1/8W, 1%, M.F.
R256	RESISTOR,	4.7K, 1/4W, COMP.
R257	RESISTOR,	1K, 1/4W, COMP.
R258	RESISTOR,	47K, 1/4W, COMP.
R259	RESISTOR,	1.10K, 1/8W, 1%, M.F.
R260	RESISTOR,	10.0K, 1/8W, 1%, M.F.
R261	RESISTOR,	8.25K, 1/8W, 1%, M.F.
R262	POTENTIOMETER,	5K, HELIPOT #72XR5K
R263	POTENTIOMETER,	5K, HELIPOT #72XR5K
R264	RESISTOR,	10K, 1/4W, COMP.
R265	RESISTOR,	9.31K, 1/8W, 1%, M.F.
R266	RESISTOR,	6.81K, 1/8W, 1%, M.F.
R267	RESISTOR,	1.21K, 1/8W, 1%, M.F.
R268	RESISTOR,	10K, 1/4W, COMP.
R269	RESISTOR,	470 OHM, 1/4W, COMP.
R270	RESISTOR,	470 OHM, 1/4W, COMP.

SYMBLDESCRIPTION

R271	RESISTOR,	10 OHM, 1W, COMP.
R272	RESISTOR,	10 OHM, 1/4W, COMP.
R273	RESISTOR,	10 OHM, 1/4W, COMP.
R274	RESISTOR,	10 OHM, 1W, COMP.
R275	RESISTOR,	10 OHM, 1/4W, COMP.
R276	RESISTOR,	10 OHM, 1/4W, COMP.
R277	RESISTOR,	10 OHM, 1W, COMP.
R278	RESISTOR,	10 OHM, 1/4W, COMP.
R279	RESISTOR,	10 OHM, 1/4W, COMP.
R280	RESISTOR,	10 OHM, 1W, COMP.
R281	RESISTOR,	10 OHM, 1/4W, COMP.
R282	RESISTOR,	10 OHM, 1/4W, COMP.
R283	RESISTOR,	10K, 2.5W, .1%, W.W.
R284	RESISTOR,	500 OHM, 1W, .1%, W.W.
R285	RESISTOR,	500 OHM, 1W, .1%, W.W.
R286	RESISTOR,	10K, 2.5W, .1%, W.W.
R287	RESISTOR,	100K, 1/4W, 1%, M.F.
R288	RESISTOR,	100K, 1/4W, 1%, M.F.
R289	RESISTOR,	105 OHM, 1/8W, 1%, M.F.
R290	RESISTOR,	1.87K, 1/8W, 1%, M.F.
R291	RESISTOR,	1.87K, 1/8W, 1%, M.F.
R292	RESISTOR,	105 OHM, 1/8W, 1%, M.F.
R293	RESISTOR,	100K, 1/4W, .1%, M.F.
R294	RESISTOR,	11.1K, 1/8W, .1%, M.F.
R295	RESISTOR,	11.1K, 1/8W, .1%, M.F.
R296	RESISTOR,	100K, 1/4W, .1%, M.F.
R297	RESISTOR,	22K, 1/4W, COMP.
R298	RESISTOR,	100 OHM, 1/4W, COMP.
R299	RESISTOR,	100 OHM, 1/4W, COMP.
R300	RESISTOR,	1 OHM, 1/4W, COMP.
R301	RESISTOR,	1 OHM, 1/4W, COMP.
S1	SWITCH,	OAK #399282-AM
S101	SWITCH,	SELCO #S0250
S102	SWITCH,	SELCO #S0280
T101	TRANSFORMER,	CEA #C3626
T201	TRANSFORMER,	CEA #C3627
T202	TRANSFORMER,	CEA #C3628
T203	TRANSFORMER,	CEA #C3628
T204	CURRENT SENSE INDUCTOR	PULSE ENG #PE-51719
T205	CURRENT SENSE INDUCTOR	PULSE ENG #PE-51719
U101	DUAL OP-AMP,	MC1558JG/883B
U102	QUAD COMPARATOR,	LM139J/883B
U103	OPTO COUPLER,	4N33
U104	OPTO COUPLER,	4N33
U201	QUAD COMPARATOR,	LM139J/883B
U202	QUAD COMPARATOR,	LM139J/883B
U203	QUAD COMPARATOR,	LM139J/883B
U204	DUAL TIMER,	SE556J
U205	JK FLIP-FLOP,	SN5470J

SYMBOLDESCRIPTION

U206	TRIPPLE 3 INPUT	SN54S11J + AND GATE
VR101	ZENER,	12V, 1N4742A
VR102	ZENER,	12V, 1N4742A
VR103	REFERENCE,	6.2V, 1N829
VR104	REFERENCE,	6.2V, 1N829
VR201	ZENER,	5.1V, 1N751A
VR202	ZENER,	12V, 1N4742A
VR203	REFERENCE,	6.2V, 1N829
VR204	REFERENCE,	6.2V, 1N829
VR205	ZENER,	5.1V, 1N751A



FAULT INDICATIONS:

IF THE VOLTAGES AT PINS 1 THRU 9 OF J3 ARE LESS THAN +12V WITH RESPECT TO NEUTRAL THEN ALL THE LISTED PARAMETERS ARE WITHIN TOLERANCE AND THE DFI LEADS (J5) WILL BE OPEN CIRCUITED.

IF A PARAMETER IS OUT OF TOLERANCE THE CORRESPONDING LEAD OF J3 WILL BE BETWEEN +12V AND +7.5V WITH RESPECT TO NEUTRAL AND THE DFI LEADS WILL BE SHORT CIRCUITED.

FIGURE 1
EXTERNAL WIRING DIAGRAM

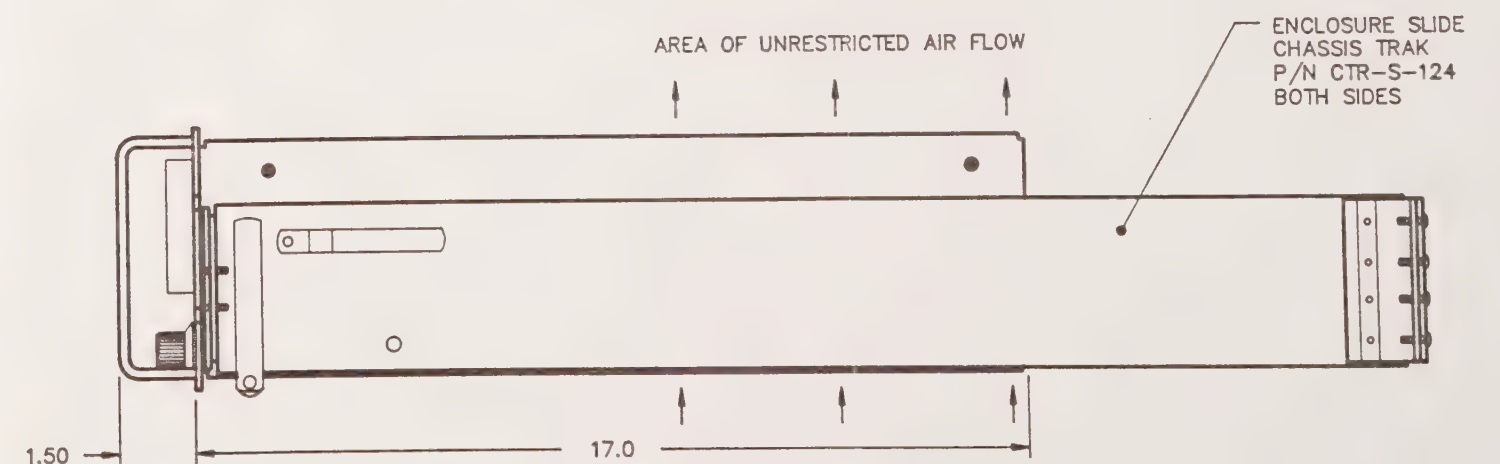
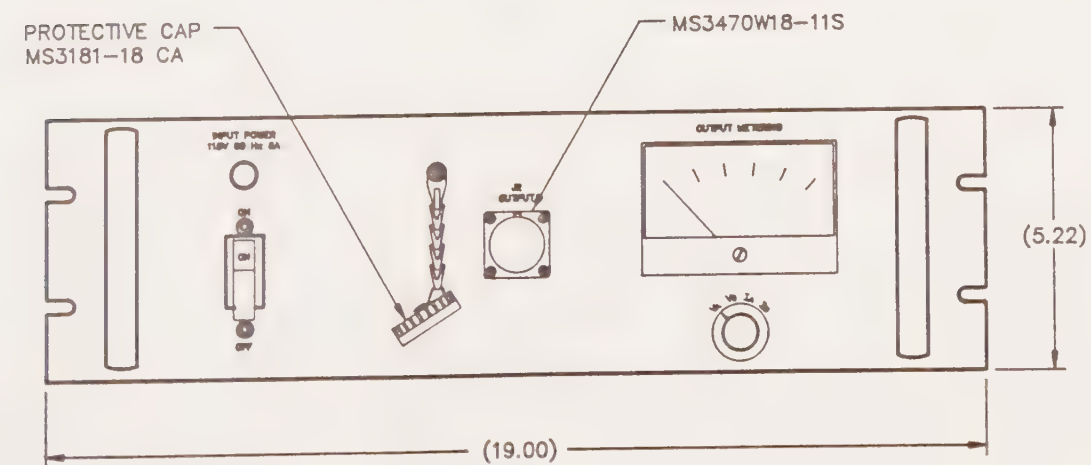
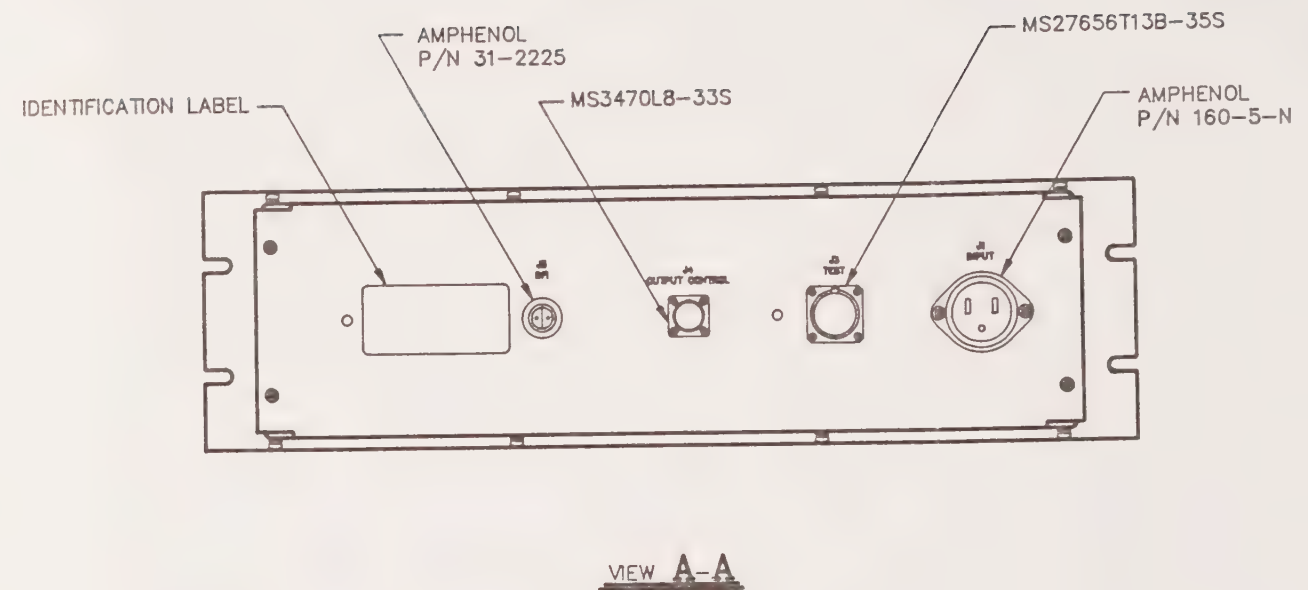
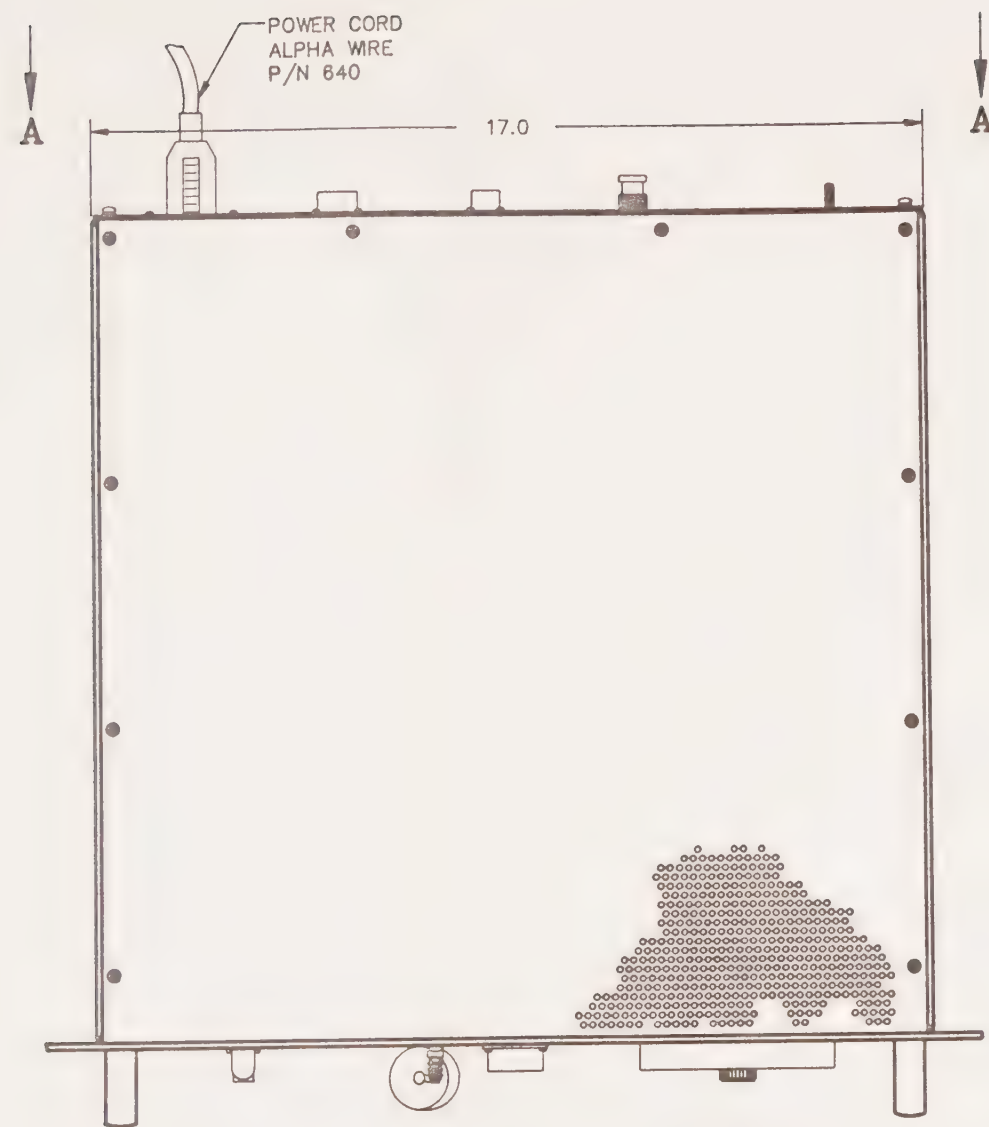


FIGURE 2
OUTLINE DRAWING

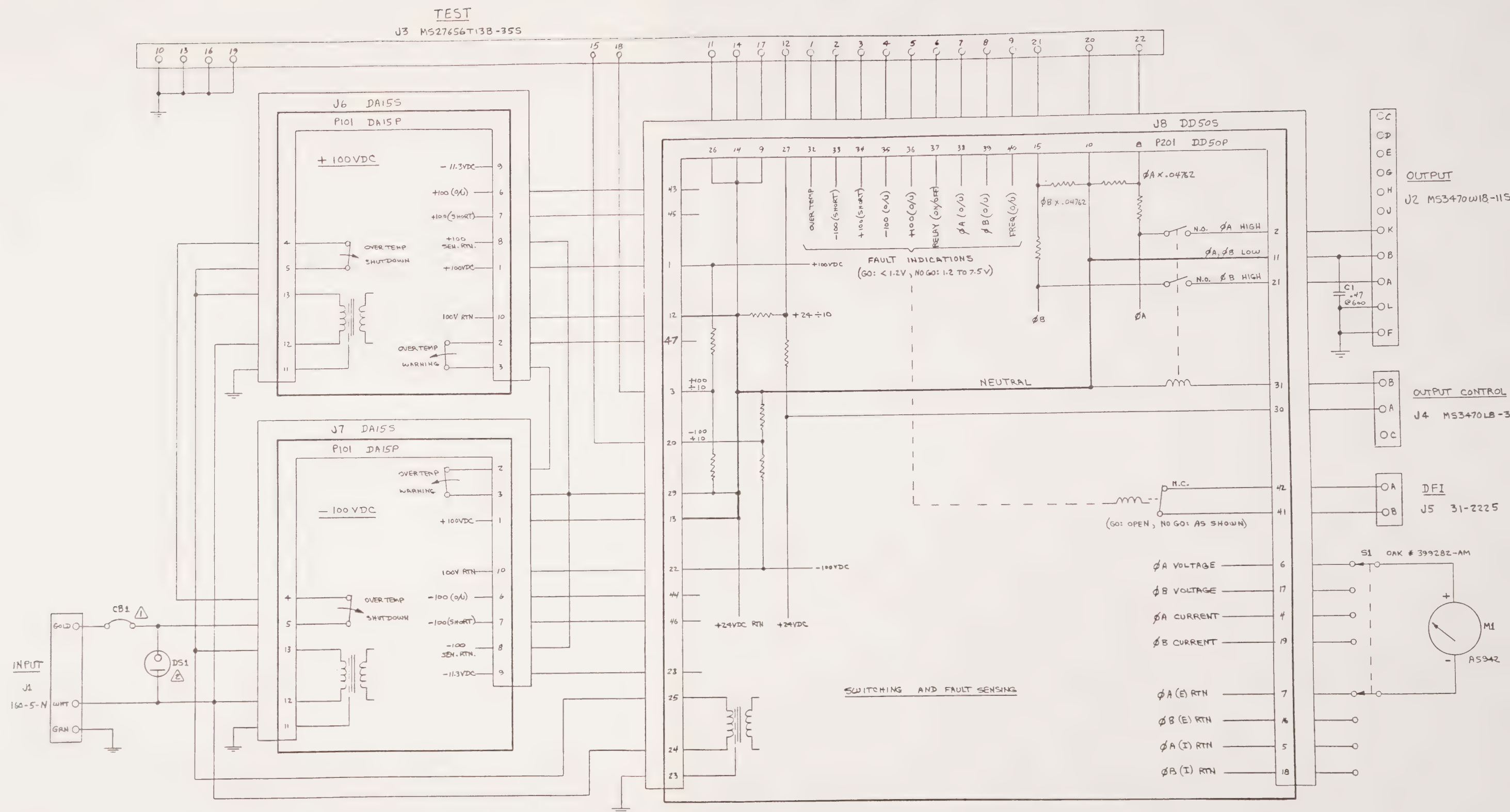
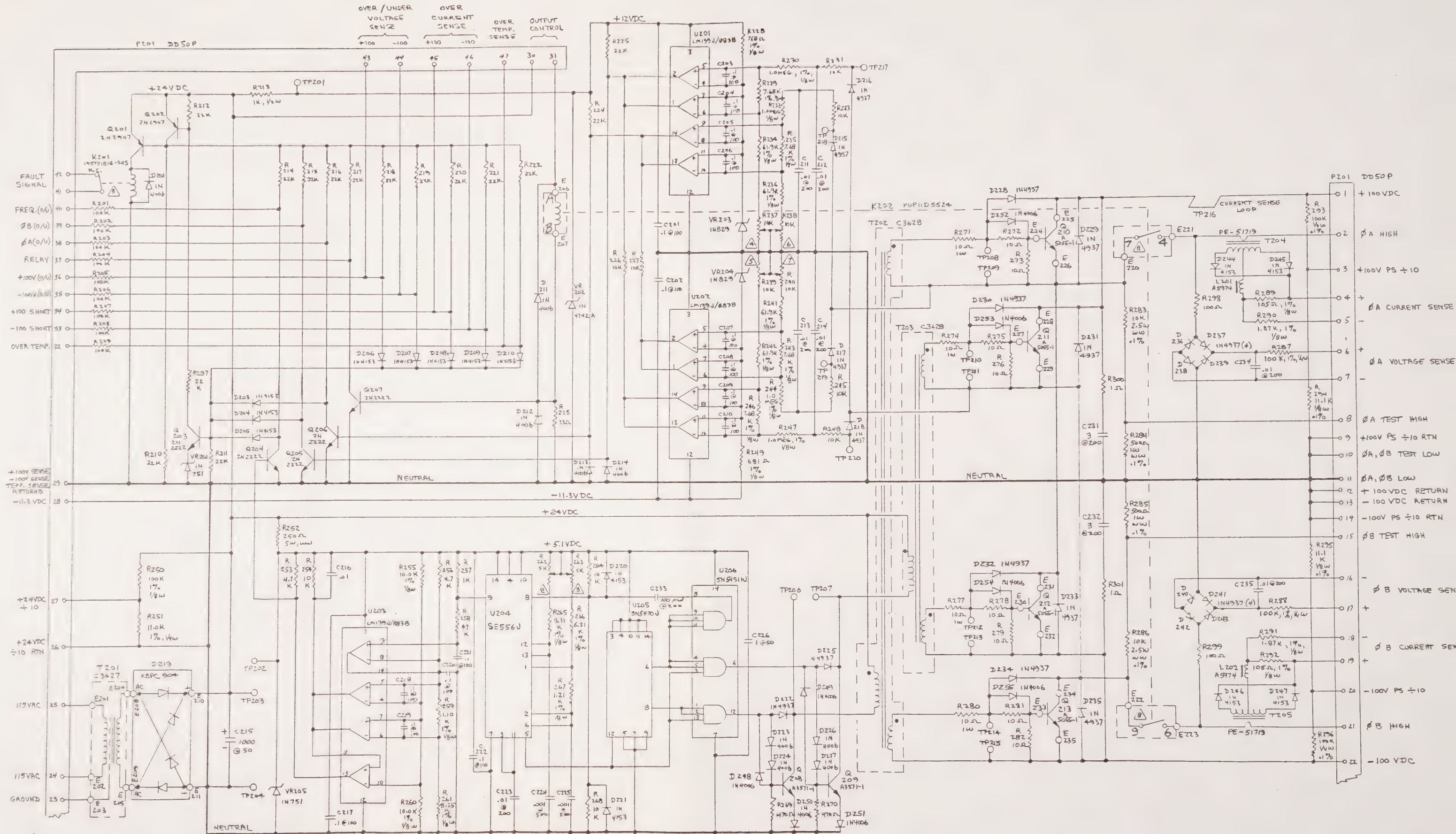


FIGURE 3

INTERCONNECTION CIRCUITS

2 LAMP HOLDER: DIALITE # 187-8836-0933-552, BULB: NE2B (C7A).
 1 AIRPAX # APL-1-1-62F-502-M OR HEINERMAN # AM1-AB-A-5-20.
 NOTES: UNLESS OTHERWISE SPECIFIED



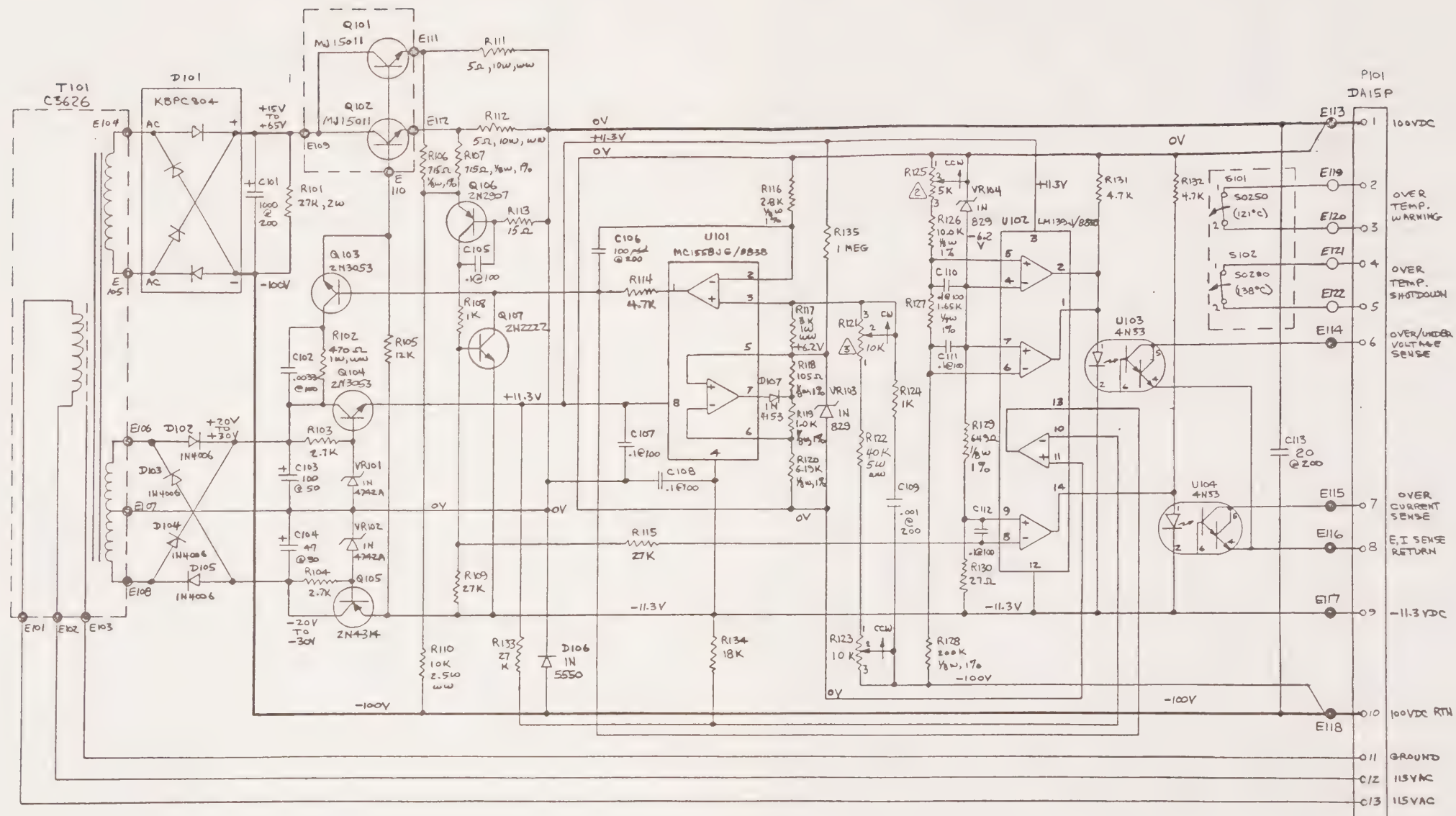
- 7 $\phi A(-)$
 6 $\phi A(+)$
 5 $\phi B(-)$
 4 $\phi B(+)$
 3 SET FOR 40KHZ.
 2 SET FOR ERROR SIGNAL @ 38KHZ AND 42 KHZ.

1. RESISTORS: $\frac{1}{4}$ W COMPOSITION, CAPACITORS IN μ FD.

NOTES: UNLESS OTHERWISE SPECIFIED

Δ RELAYS SHOWN NON ENERGIZED.

FIGURE 4
 INVERTER CIRCUIT



- 3 SET FOR 101V OUT WITH R123 AT CENTER OF ITS RANGE.
 2 SET FOR ERROR INDICATION BETWEEN 106 AND 107V.
 1. RESISTORS: 1/4W COMPOSITION, CAPACITORS IN µSD.
 NOTES: UNLESS OTHERWISE SPECIFIED

FIGURE 5
 100VDC POWER SUPPLY CIRCUIT
 PAGE 24

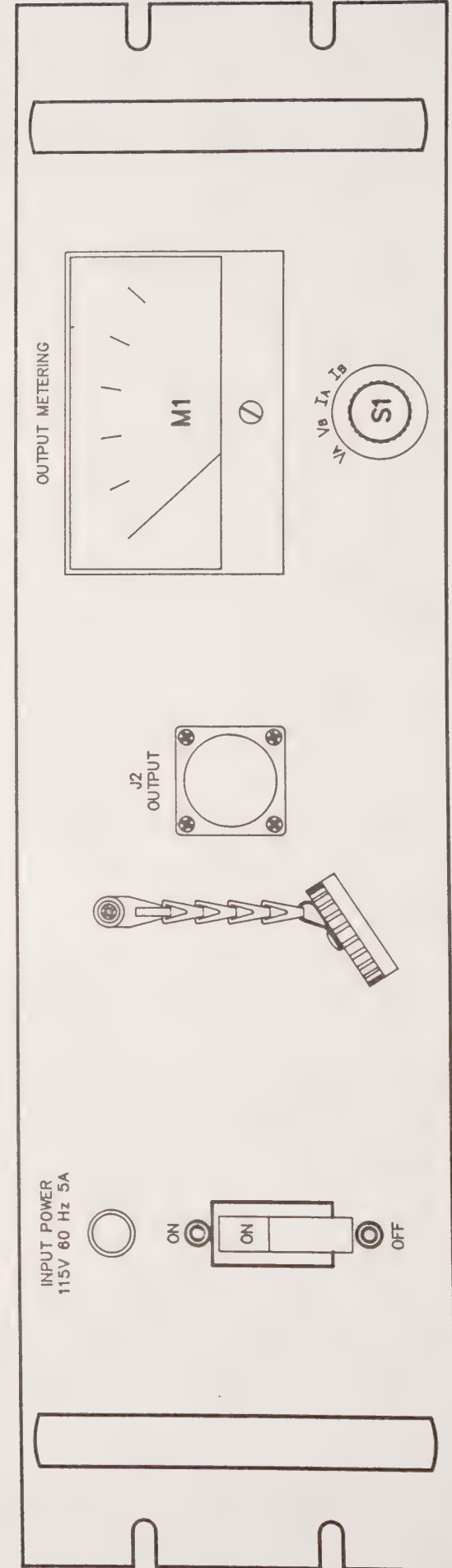
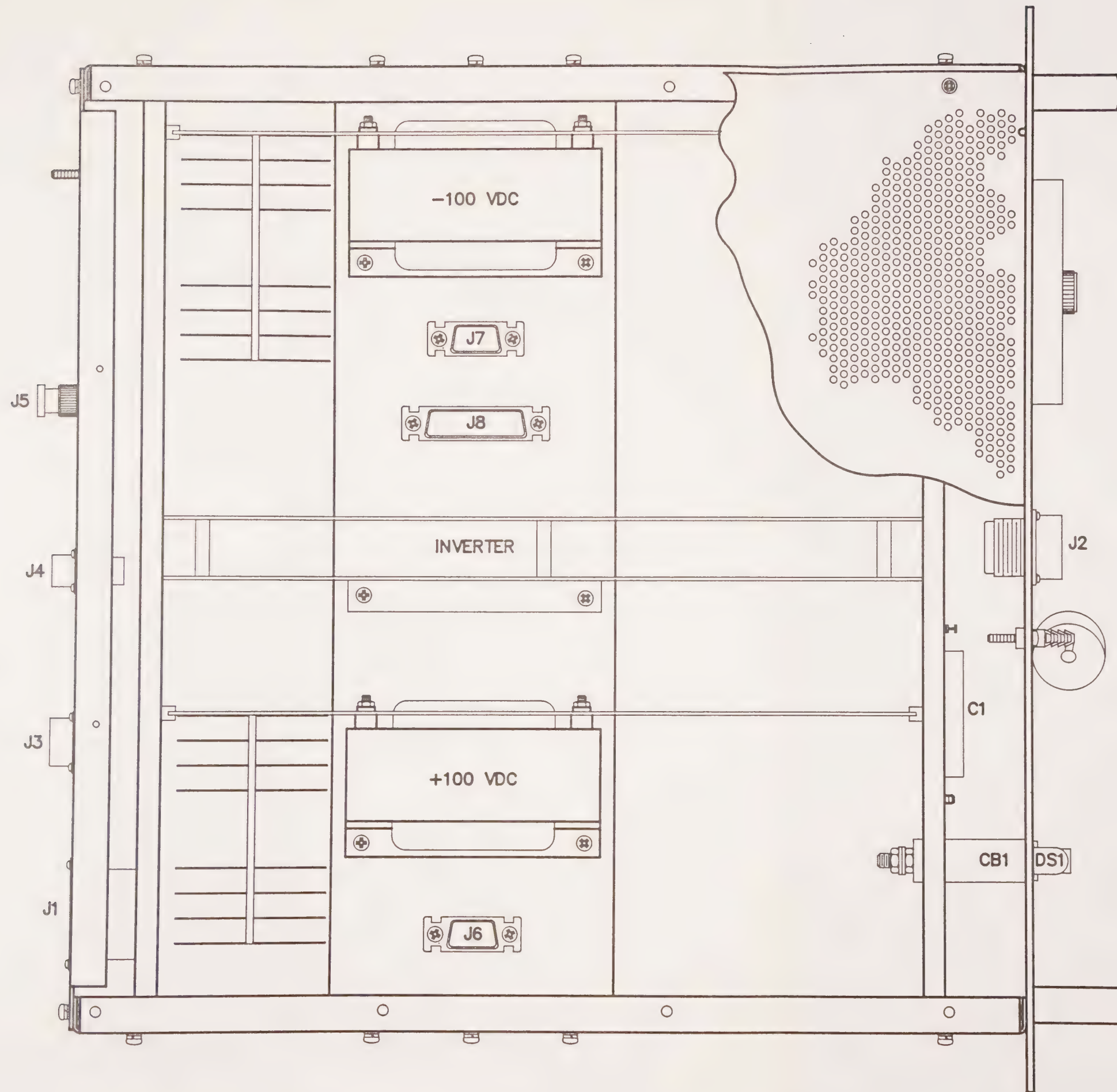


FIGURE 6
FINAL ASSEMBLY
PAGE 25

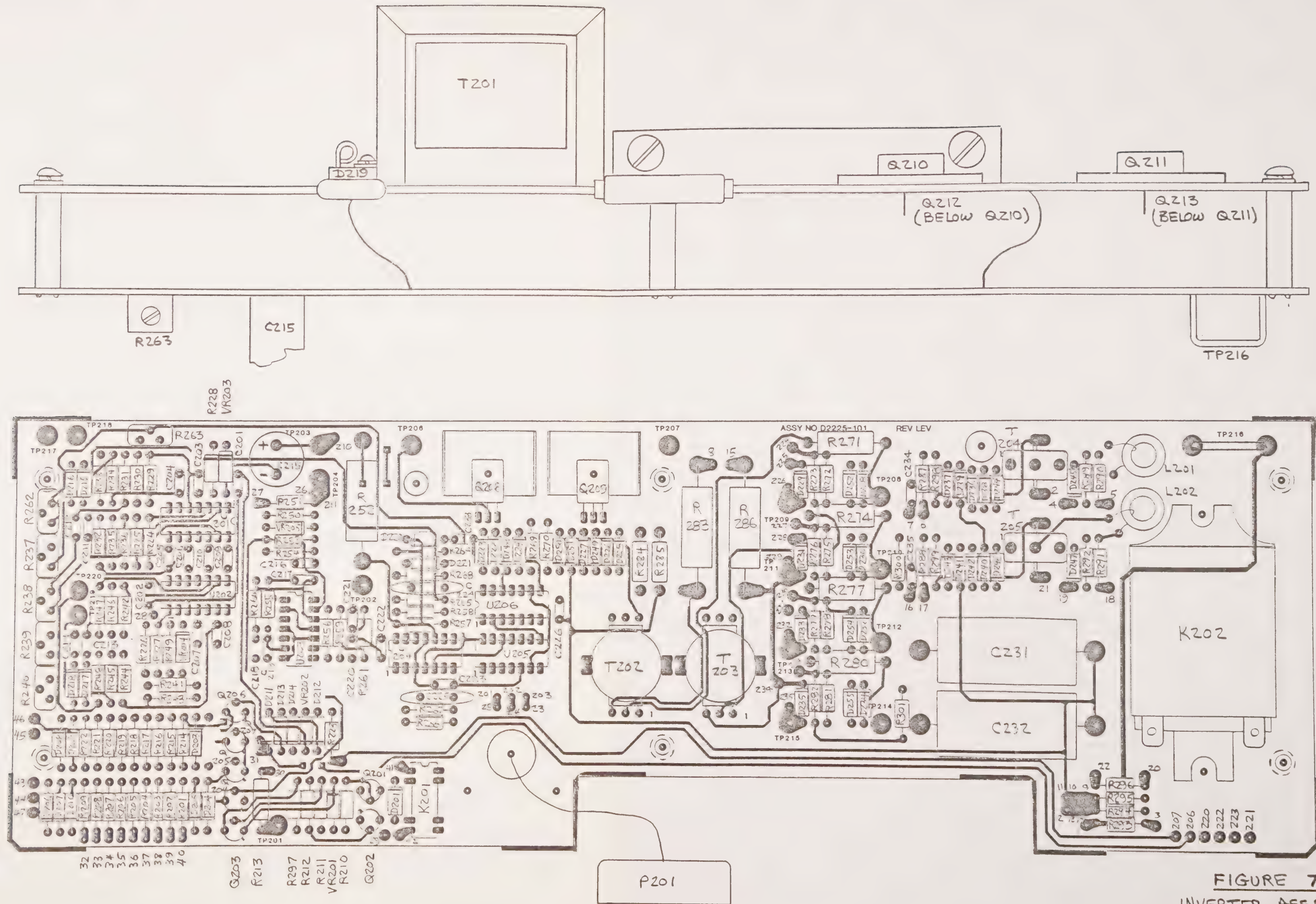
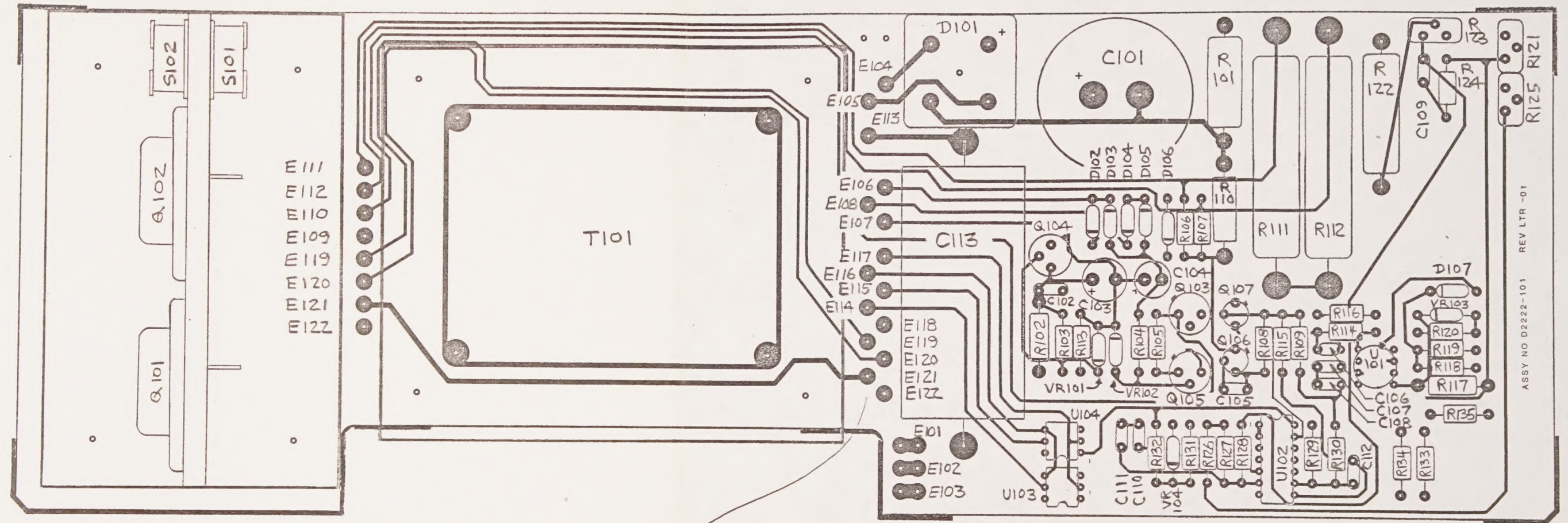


FIGURE 7
INVERTER ASSEMBLY



P101

FIGURE 8

100VDC POWER SUPPLY ASSEMBLY

MP MASTER



MA24620